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IS IT TIME FOR A SATCOM CIVIL RESERVE FLEET?

by

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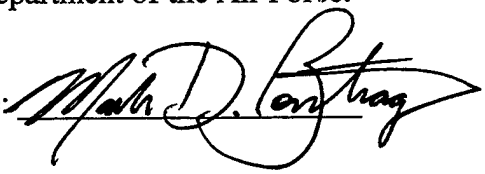
The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College, the Department of the Navy, or the Department of the Air Force.

Signature: 

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Three frameworks have been proposed to mitigate this surge-capacity problem. A Civil Reserve Air Fleet (CRAF) framework calls for establishing a commercial satellite backup capability that can be tapped when a crisis erupts. A spot market lease framework calls for buying capacity on the open market when needed. A cascade strategy framework moves MILSATCOM users to commercial SATCOM to free-up military capacity for the high-priority operational users.

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Abstract of

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The US military depends upon satellite communications (SATCOM) like never before. However, dedicated military SATCOM (MILSATCOM) does not provide enough capacity to meet the demands of today's warfighters. Current plans call for commercial SATCOM to fill the capacity gap. Unfortunately, the capacity just isn't there. Nor can it respond quickly enough to meet the surge-capacity needs of US quick-response forces.

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Every credible vision for future US military capability demands assured, reliable, secure and ubiquitous communications. The US military will be "wired" like never before. From the foxhole to the combat support logistician to the Joint Forces Commander, every member of the joint military team will require almost constant, real-time communications.

The need for connectivity is not new. Through the evolution of warfare, the side that was able to gather, process and disseminate critical information the fastest, had the advantage in battle. What is new is the exponential growth and demand for information transfer that will mark warfare in the 21st century.

Not only will the demand grow, but it is virtually impossible to determine where and when the communication capability will be needed before the demand skyrockets. Since the end of the Cold War, the US military has deployed to a myriad of locations with little or no strategic warning. In many cases, the US military deployed to establish operating bases in theaters with primitive communication infrastructures. In these cases, the US military has transformed the communications capacity from virtually nothing, to a full-blown network-centric communication hub.

All of this has been made possible by the use of satellite communications (SATCOM). In these remote regions, with little or no terrestrial communications infrastructure, SATCOM has been there, ready to satisfy a significant portion of the communication needs. "Where in the past the US had to drag much of its support infrastructure to distant places, the in-place space-based information infrastructure allows us to minimize such projection requirements.[1]

However, in tomorrow's network-centric environment, will there be enough capacity in our SATCOM pipelines to provide all of the connectivity the warfighters will demand? Although the military has dedicated communication satellites (MILSATCOM), they do not provide enough capacity to meet the needs of today's deploying forces.[2] For example, at the beginning of Desert Shield, the demand for satellite communications quickly outstripped available resources.[3]

Since Desert Storm, the demand has continued to grow. As figure 1 shows, the aggregate MILSATCOM capacity needed to support U.S. forces in two major regional conflicts (MRCs) in 2005 range from 2.5 to 20 Gbps[4], a factor of up to 100 times larger than the total capacity used by US forces during Desert Storm.[5] Beyond 2005, the demand is projected to grow exponentially.

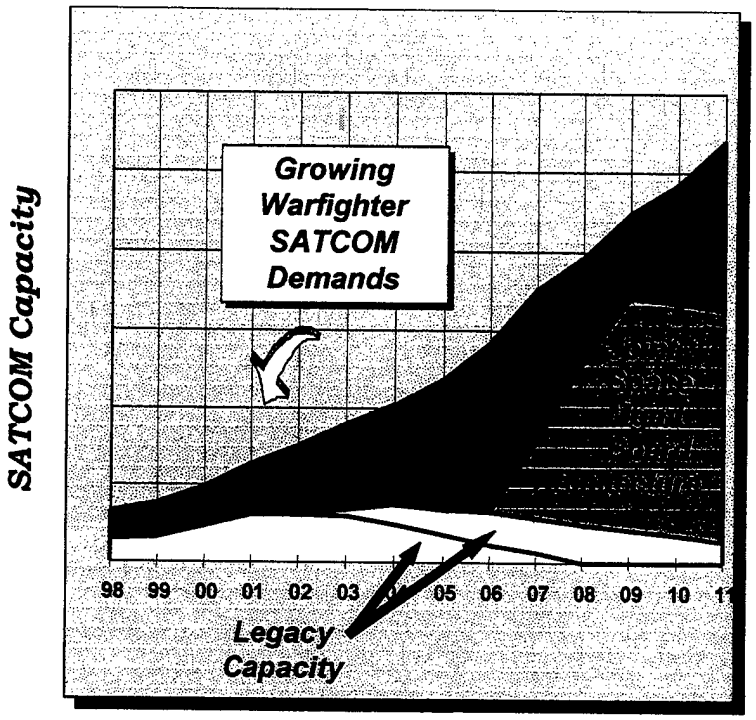

Figure 1: Challenges to Military SATCOM[6]

Concurrent to the military's growing demand for SATCOM, there has been enormous investment in the commercial SATCOM sector to meet growing commercial demand (investment has been estimated at $500 billion from 1995 to 2000).[7] As a result, the military is significantly utilizing the commercial SATCOM market to fill the gap between MILSATCOM capacity and warfighter requirements.[8] The Defense Information System Agency (DISA), which currently buys $200 million of commercial satellite service annually, will soon see its expenditures grow to almost $500 million under multiple contracts.[9]

However, in the event of a major regional conflict, the real challenge will be acquiring enough capacity in a short time to meet all of the military requirements. This "surge-capacity" problem will be exacerbated by the tremendous demand by both military and commercial users for this very limited commodity.

United States Space Command (USSPACECOM), in its Long Range Plan, suggests that the solution to this problem is to develop mobilization plans (Civil Reserve Air Fleet [CRAF] or other similar ideas) that ensure commercial services are available when needed.[10] The idea is to take advantage of commercial capabilities for military purposes. For airlift, the CRAF is a very cost-effective framework. With the CRAF, commercial airlines voluntarily commit a certain amount and type of aircraft to be used for military purposes only when the CRAF is activated. It provides a surge capacity during times of crisis or war. A similar conceptual framework could be applied to commercial SATCOM and could be called a SATCOM Civil Reserve Fleet (CRF).

This paper will evaluate the SATCOM CRF model to determine if it is the best framework to apply to meet the surge-capacity requirements of operational commanders. This paper will also evaluate a second and a third conceptual framework to contrast the advantages and disadvantages of the SATCOM CRF framework. The second conceptual framework suggests that the DoD should lease commercial SATCOM on the spot market when a crisis erupts. The third conceptual framework is known as the cascade strategy. In the cascade strategy, MILSATCOM resources are made available by temporarily moving some users from MILSATCOM to commercial SATCOM or fiber-optic cables.[11] This framework allows the "freed-up" resources to be used to meet surge requirements. Another conceptual framework where the DoD would directly procure new commercial satellites to meet surge-capacity is discussed in Appendix A.

How do we meet the SATCOM needs of operational commanders today? How does commercial SATCOM fit into the overall picture?

CURRENT CAPABILITIES AND COMMERCIAL SATCOM AUGMENTATION

MILSATCOM is designed and built for military users and is grouped into three categories (see figure 2). Protected systems, like the Milstar satellites, provide very secure, jam resistant communications to high-priority users world-wide. Wideband systems, like the Defense Satellite Communications System (DSCS) provide high-capacity communications. For example, the most-recently-upgraded DSCS satellites will have a capacity of 200 Mbps that is double the capacity of the current satellites on orbit.[12] Systems designed to support mobile users, like the Navy's UHF Follow-On (UFO) satellites, provide networked multi-party and point-to-point communications to thousands of mobile warfighters.[13] All of these systems are augmented by commercial SATCOM. Figure 2 shows a projected architecture that was approved by the Joint Requirements Oversight Council in October 1997.

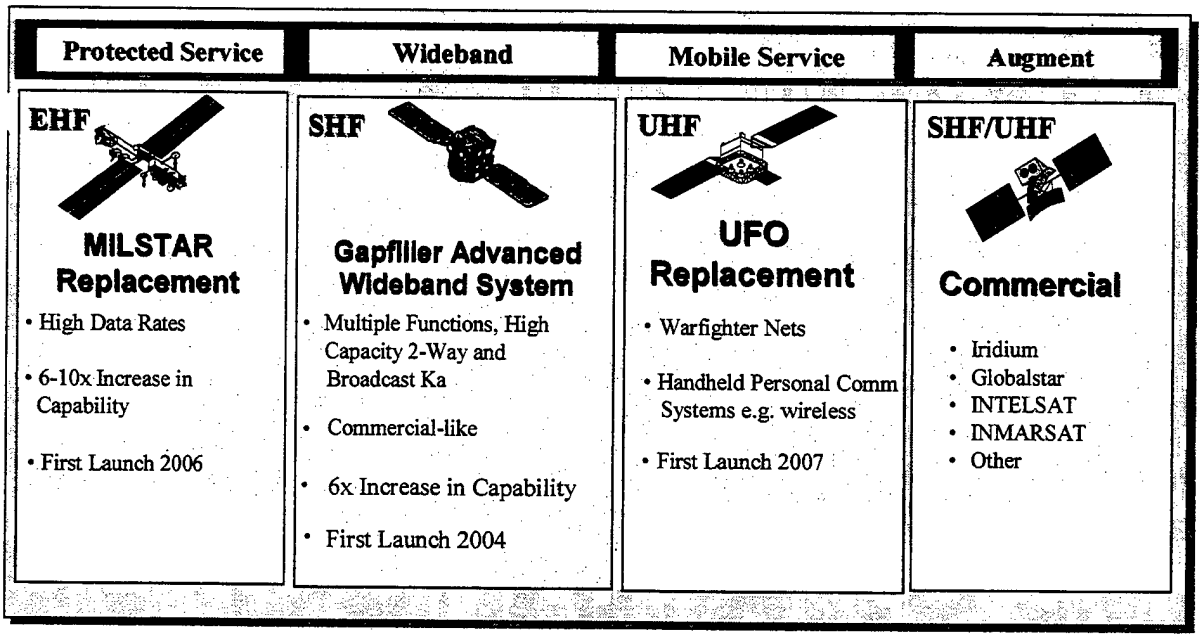

Figure 2: JROC Baseline Replaces Current Systems and Enhances Commercial Augmentation[14]

Before Desert Storm, commercial SATCOM augmentation was purchased in an ad hoc fashion with different operational users acquiring commercial SATCOM tailored to meet their specific needs. As a result, the DoD lacked a central office to consolidate commercial SATCOM

leasing. In response to congressional direction, the Commercial Satellite Communication Initiative (CSCI) was established under DISA in 1994 to provide commercial transponders[15] worldwide. CSCI is tasked to (1) reduce the long-term cost of providing commercial SATCOM support to all DoD customers; and (2) provide pre-positioned surge capability to support the Joint Task Force (JTF) and related missions.[16] One example of a CSCI initiative is the Navy's Challenge Athena III program that supports day-to-day operations and extends the Defense Information System Network to the fleet.

Currently however, the CSCI leases only full transponders. This approach has inherent inefficiencies since the usage rate of individual transponders on the average is relatively low (less than 50%).[17] Frequently, military requirements can be met with less than a full transponder. It is in this area of partial transponders that potentially large capacity exists. To fix that shortfall, CSCI will soon have a contract vehicle to provide partial transponders.

Another service that is available through a Government Services Agency (GSA) contract is Hughes Global Services (HGS). HGS provides end-to-end SATCOM services to government entities. It offers its customers 'one stop shopping' for integrated, worldwide satellite communications.[18] HGS keeps track of available commercial SATCOM capacity and serves as a broker between the users and the providers. It's ability to access many different providers opens up flexible options to meet user requirements. HGS is available online and can be very responsive to customer needs. For example, if an operational user needed only 2-4 Mbps of commercial SATCOM anywhere in the world, HGS should be able to meet that requirement within a few days.

The DoD Mobile Satellite System program will allow the DoD to access and leverage emerging commercial narrowband systems.[19] Narrowband systems are designed to meet the needs of mobile users. Today, systems like Iridium and Globalstar have demonstrated the technical ability to provide worldwide voice and low data rate service to small, lightweight handsets. These systems could be used to augment tactical communication nets.

In the far term category, some new high data rate systems may appear on the commercial market in the next 5-10 years. Examples of high data rate systems that have filed with the Federal

Communication Commission are Teledesic and Hughes' GALAXY/SPACEWAY. This new generation of processed "bandwidth-on-demand"[20] satellites will provide global coverage and are targeting the future market for 'information superhighway' applications.[21] Anticipated capacity for these systems range from 16 Kbps to as high as 1.244 Gbps. The commercial viability of these systems must be taken into consideration. Significant competition for these systems will come from land-based hybrid fiber-optic/cable systems and other land-based services. These land-based lines can transfer significantly more data per second than SATCOM systems. For example, one proposed [fiber optic] line from New Jersey to the Mediterranean can carry 10 Gbps and will later support 40 Gbps.[22] Thus, the military must be careful not to commit to a SATCOM system before it is commercially viable. However, if these systems become operational, the concept of "bandwidth-on-demand" offers some attractive opportunities for innovative concepts that could be mutually beneficial for the government and the commercial providers.[23]

OPERATIONAL USER REQUIREMENTS

Before evaluating the various frameworks, it will be important to understand the different types of communication requirements levied by today's operational commanders. These users can be separated into three categories: hard core, core, and general purpose[25] (see figure 3).

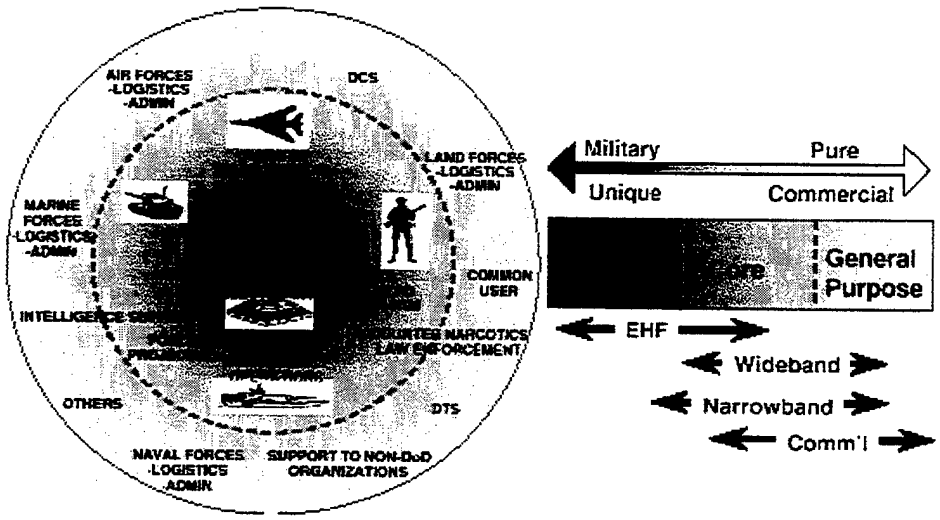

Figure 3: Range of Operational Users of SATCOM[24]

The hard-core category serves users that require high levels of protection and nuclear survivability. These systems are used for nuclear force alerting, single integrated operating plan (SIOP) execution and CINC strategic nets. For the foreseeable future, these requirements must be met by dedicated, military-unique, MILSATCOM systems that provide the necessary levels of protection, assured connectivity and the ability to operate in a threat environment. Commercial systems simply do not have the protection mechanisms in place to counter such threats as uplink and downlink jamming, signals intelligence, electronic exploitation, information attack, physical destruction and nuclear effects.[26] Mission critical information would be dedicated to this hard-core category.

The core category serves those operational users that are primarily at the tactical level. Many core users require the protection offered by MILSATCOM systems such as Low Probability of Intercept (LPI), Low Probability of Detection (LPD), and robust anti-jam capability. However, some core user communication requirements can be met by commercial systems. In many cases, slight modifications to the user equipment can provide a degree of protection that would allow use of commercial systems. For example, the Universal Modem can provide encryption that can protect from electronic exploitation. Another example is Mitre's Interference Mitigation Appliqué for Mobile Handsets that allows a commercial cellular phone to maintain a communication link in the presence of interference.[27]

The general-purpose category serves infrastructure users, logistics, administrative, and morale and welfare functions. Non-critical communications fit this category since the requirements for protection and security are not mandatory. This category lends itself to commercial SATCOM because most general-purpose users are large, fixed users that are similar to most commercial businesses that need dedicated Fixed Satellite Service (FSS) commercial SATCOM transponders.

In summary, hard-core and many of the core users will be forced to rely on MILSATCOM for their communications. As a result, the US will continue to acquire dedicated MILSATCOM systems to meet the needs of those operational users. In addition, some of the core users and the

majority of the general-purpose users are candidates for commercial SATCOM. Actually, many of the general-purpose users rely more heavily on commercial SATCOM today.[28]

However, what happens when a conflict erupts and US forces quickly deploy to an immature theater? When a contingency arises, communication requirements can increase 50% or more, over prior planning forecasts.[29] This problem will only get worse as the demand for connectivity increases. How will an operational commander ensure that the surge-capacity is available when needed? What conceptual framework will best provide commercial SATCOM to meet the operational commander's requirements?

CONCEPTUAL FRAMEWORK EVALUATION METHODOLOGY

This paper will evaluate three proposed frameworks to solve the surge capacity problem: 1) SATCOM CRF, 2) Spot Market Leasing, and 3) Cascade Strategy. Each proposed conceptual framework will be evaluated on the basis of its ability to meet operational requirements identified in a DISA "what if" study that projected to meet SATCOM capacity requirements during a contingency operation[30]

The commercial SATCOM market is rapidly changing and new capabilities are continually being introduced. Thus, each framework will be evaluated in light of current and future systems and their ability to meet near-term and far-term operational requirements. The following factors will be discussed for each framework.

Availability: Does this framework ensure that there is enough commercial SATCOM capacity available to meet surge requirements?

Incentives: Does this framework include sufficient incentives to entice commercial SATCOM providers to partner with the government?

US Control: Will this framework provide US control of the commercial SATCOM resources to ensure support to US forces in any contingency?

Legacy Equipment: Will this framework take advantage of the millions of dollars of communication terminals currently fielded for military use?

Host Nation Approval (HNA) Pre-negotiated: To terminate commercial service in a foreign country, it is necessary to obtain host nation approval (HNA). Sometimes this process can take up to two years. Will this framework ensure pre-negotiation of HNA to meet the short timelines for surge capacity?

Global Coverage: Will this framework ensure that commercial SATCOM will be available in any region of the globe?

Cost Effective: Will this framework be a cost-effective way to meet surge-capacity requirements?

Operational Responsiveness: Considering all factors, will this framework provide the operational commander with enough capacity to meet the surge requirements?

CONCEPTUAL FRAMEWORKS DEFINED/EVALUATED

SATCOM Civil Reserve Fleet

The first conceptual framework for providing a surge capacity for SATCOM is one that has been proposed by USSPACECOM in its Long Range Plan where it calls for a CRAF-like concept to ensure commercial SATCOM resources are available when needed. Specifically applied to SATCOM, it could be called a SATCOM Civil Reserve Fleet (CRF).

The model is analogous to the Air Force CRAF concept. With the CRAF, commercial airlines voluntarily commit a certain amount and type of aircraft to be used only when the CRAF is activated. In return, the government promises passenger business in proportion to their CRAF commitment. This has been the primary incentive for airline involvement with the CRAF program. In addition, airlines have received government business for many years without a CRAF activation. The CRAF has only been activated one time since its inception in 1952 and that was during Desert Shield/Desert Storm.[31]

The CRAF has been of significant benefit to the military by providing over ninety percent of the Air Force's long-range passenger-carrying capability.[32] It has also been very cost effective. The military only pays for the aircraft when they are used. If the military had procured aircraft to meet it's

requirements, a RAND study suggests that it would have cost DoD about $1 billion to $3 billion annually over the past 30 years.[33] In summary, the government gets the security of a surge capacity for airlift without the requisite maintenance of an organic capability and the airlines get guaranteed business.

The SATCOM CRF framework would theoretically apply the same model to SATCOM. However, there are some significant differences that need to be explored.

Availability: In the CRAF model, there are hundreds of aircraft in the inventories of the US airlines. When the CRAF is activated, airlines are able to reschedule and consolidate flights to meet both commercial and military obligations.

However, commercial SATCOM resources are not as available as aircraft. Every bit of data that flows through a commercial satellite is revenue for a commercial provider; thus there is very little surge capacity. For example, DISA did a "what if" study related to Operational Allied Force. To meet the needs of a given scenario, they surveyed the available commercial capacity. All of the requirements that could not be met by MILSATCOM were slated to be met by commercial SATCOM. The results showed that commercial SATCOM providers could only meet 15-20 percent of the total commercial SATCOM requirements. Thus 80-85 percent of the commercial SATCOM requirements would go unmet. A sobering observation of this analysis is that the DoD cannot simply assume that the commercial market will be able to accommodate surge requirements.[34]

However, with some financial investment, innovative contracting approaches, and pre-crisis planning by operational users, more commercial SATCOM capacity may become available to military users. Some examples of innovative approaches are First Right of Refusal and Preemptable Transponders.

The First Right of Refusal (FRR) approach allows a user to pay a fee to "hold" a transponder for a period of time (i.e. 6 months). If another user wants to purchase that transponder, the buyer of the FRR must either release it's "hold" or purchase the entire capacity of the transponder. This option may allow a regional Commander In Chief (CINC) to hold commercial SATCOM capacity for a short

period of time (in anticipation of a possible contingency) without purchasing the entire transponder. However, this approach may not always be a cost-effective way to ensure availability because another user that needs capacity can challenge the "hold" at any time.

Another approach is the use of preemptable transponders. Preemptable transponders are used frequently in the commercial marketplace. A preemptable transponder is one that is leased from a provider and then the capacity is placed back on the market with the right to preempt the current user if necessary. Most business entities that lease preemptable transponders prefer a minimum of 30 days notice to vacate a transponder. This would theoretically allow them enough time to find other communications capacity to meet their needs. With this innovative approach, the operational user would lease enough transponders from a commercial SATCOM provider to meet its surge requirements. Excess, unneeded capacity would then be resold as preemptable transponders. This would allow the government to have surge-capacity when needed without the cost of maintaining unused capacity. All of these innovative approaches would require some up-front funding by the DoD and some pre-crisis planning by operational commanders, but may ensure more commercial SATCOM availability in a surge scenario.

For the far term, as high data rate constellations like Teledesic and Hughes, GALAXY/SPACEWAY come on-line, additional CRAF-like options become more feasible. These future systems have built-in flexibility, "bandwidth-on-demand," that allows them to simply 'gracefully degrade' some customers' data rates instead of removing them completely. This is similar in concept to slower Internet downloads during busy periods.[35] Like the CRAF, where flights are rescheduled or consolidated to meet both commercial and military demand, these future high data rate systems offer flexibility unlike today's commercial SATCOM.

Incentives: A primary incentive for airline participation in the CRAF is the guarantee of government travel business. For example, those airlines that are not members of the CRAF are not entitled to receive any peacetime government business[36] However, CRAF activation can have significant negative economic consequences to an airline when aircraft are removed from a market to

meet government needs.[37] Overall, since the CRAF has only been activated once since 1952, the guarantee of government business has been a major incentive for airline participation.

However, commercial SATCOM providers have no similar incentive to participate in a SATCOM CRF. The majority of military satellite communications during peacetime are carried over dedicated MILSATCOM systems. In addition, the DoD already has numerous leases with commercial SATCOM providers and it would be difficult, at this point, to hold them back and reissue the leases as an incentive for CRAF participation.[38] Thus, there is little incentive for commercial providers to participate in a SATCOM CRF.

For the far term, high data rate systems may offer some incentive for commercial participation. As these systems become more financially viable, the military should begin working with these providers to guarantee the military a certain percentage of system capacity at special military rates.[39]

US Control: Only US carriers are eligible to participate in the CRAF program. This allows US carriers to contract with foreign airlines to carry commercial traffic dispersed by the CRAF activation.[40]

In contrast, there are very few commercial SATCOM providers that are solely US owned and operated. By its very nature, the commercial SATCOM business is international and, as a result, many commercial SATCOM providers are international consortiums. This poses a potential challenge to military forces and their use of commercial SATCOM.

> Foreign Comsat owners or shareholders may deny system access to US forces if they object to US military or foreign policy objectives or if they wish to remain neutral in a conflict. Although foreign shareholders cannot deny U.S. forces system access in the United States or allied countries, international frequency allocation agreements may allow them to deny system access in their own country, and they may influence neighboring countries to do the same.[41]

Thus, internationally owned commercial SATCOM entities may make it difficult to activate a SATCOM CRF without international acceptance of US policy objectives.

Legacy Equipment: For the CRAF, the military customer looks like the commercial customer.[42] Although CRAF carriers were once paid to modify their aircraft to meet specific military missions, this is no longer done.[43]

For commercial SATCOM, the military and commercial users can be very different. For example, most military users require rugged and transportable terminals.[44] Commercial providers would be required to make expensive modifications to their existing terminals in order to meet military requirements. One study estimated that ruggedization of commercial terminals increases their cost by 43%.[45] In addition, many of these terminals would sit around until CRF activation. Thus, a SATCOM CRF may not be able to meet the needs of the US military forces in many areas of the world simply because they would not have the terminals in place.

In addition, the DoD has over 20,000 SATCOM terminals of all types and sizes to support its missions worldwide. With millions of dollars already invested by the services, and operational systems dependent upon them, we can't simply throw them away. The terminals or a functional equivalent will be required.[46] Thus, it would be cost-prohibitive to transition from these legacy terminals to newer terminals.

One promising development is that all new military terminals will be acquired with the ability to access some commercial frequency bands.[47] These terminals would be able to take advantage of both MILSATCOM and commercial SATCOM systems. Another far-term development that may be able to mitigate the problem of incompatible terminals would be a programmable communications system. Digital technology advances make it possible to produce terminals that can operate with virtually any military or commercial system by using programmable software without changing hardware.[48] Thus, in the far-term there may be many ways to link the legacy equipment with commercial SATCOM.

HNA Pre-negotiated: Before a US military aircraft or CRAF airline flies through foreign airspace or lands at a foreign airport, diplomatic clearance is required. Although some clearances

take two to three weeks for approval, the processes are relatively standard. Host Nation Approval (HNA) is also known as "landing rights."

For Commercial SATCOM, HNA is also required before a satellite terminal can be operated within a country. This process can range from a few days to two years. This fact alone significantly impacts the ability of commercial SATCOM to meet surge requirements since the HNA approval process could be exceptionally lengthy. In addition, it would be difficult to secure HNA approval in advance since deployment locations are unpredictable.[49]

For the far term, the high data rate systems will provide global coverage and will have already negotiated HNA with most nations around the world.

Global Coverage: CRAF airlines have the range to fly virtually anywhere on the globe. There are relatively few countries that cannot support a commercial airline.

In contrast, most commercial SATCOM providers design their systems to provide communication services to the highly populated areas of the world. Military forces do not always operate near highly populated areas and commercial solutions may be sparse.[50]

Cost Effective: If the SATCOM CRF framework could be implemented in accordance with the CRAF model, it would be a very cost effective way to provide surge capacity. Since the assets would only be activated when needed, it would be cheaper than maintaining an organic SATCOM capacity to meet all surge requirements.

Operational Responsiveness: At first glance, it appears that a SATCOM CRF could work much like the airlift CRAF to meet surge requirements. However, there are significant differences that make a direct application of a CRAF-like solution untenable. Issues such as: lack of available commercial SATCOM transponders, lack of adequate incentives for commercial SATCOM providers, foreign ownership/control of commercial SATCOM, unique commercial SATCOM terminals, and potentially lengthy HNA processes would make this conceptual framework difficult to implement. However, with effective pre-crisis planning by operational users, innovative acquisition

strategies, and some up-front investment, many elements of a SATCOM CRF could contribute significantly to meet surge requirements.

	SATCOM CRF-Near Term	SATCOM CRF-Far Term
Availability?	No	Yes -- with high data rate systems
Incentives?	No	No
US Control?	No	No
Legacy Equipment?	No	Yes -- with advanced technology
HNA Pre-negotiated?	No	Yes -- with high data rate systems
Regional Coverage?	No	Yes
Cost Effective?	Yes	Yes
Operational Responsiveness?	No	Yes

Table 1: SATCOM CRF Framework Summary

Spot Market Leasing

The second conceptual framework proposes that the DoD should lease SATCOM on the spot market to provide surge capacity. This framework proposes waiting until a crisis erupts, and then acquiring, on the spot market, the capacity needed from commercial SATCOM providers.

Availability: First, if there is enough capacity available on the commercial SATCOM market, this framework allows the US to purchase all capacity needed to support our military forces. However, these lease options assume that commercial providers have excess capacity to sell. As was shown in the SATCOM CRF framework, there is little excess capacity available today in the commercial SATCOM marketplace. In addition, commercial providers will often lower prices to stimulate market demand. Thus, the Comsat spot market may not be able to provide large amounts of capacity to US forces on short notice.[51] This lack of capacity may change in the far-term, but for the near-term, commercial SATCOM is a relatively rare commodity.

Incentives: The primary incentive for commercial SATCOM providers will be revenue. Thus, the DoD is simply another customer and may be required to pay top-dollar for the capacity.

US Control, Legacy Equipment, HNA Pre-negotiated, and Regional Coverage: These factors would have the same advantages and disadvantages as discussed in the SATCOM CRF above.

Cost Effective: When commercial SATCOM is leased for short-term surge requirements, the DoD only pays for the capacity that is used. Thus, it could be very cost effective. However, without pre-negotiated contracts this framework could also become a very expensive option because the DoD would be competing for a limited resource on the open market. As a result, it could become very expensive. When a crisis erupts, the demand for SATCOM grows not only from DoD but also newsgathering organizations such as Cable News Network (CNN) who are often willing to pay more than the DoD for service. Thus, this framework could be very expensive to implement.

Operational Responsiveness: In the near term, the spot market leasing framework may be able to meet some of the surge-capacity requirements, but it is unlikely that it would have the ability to meet all of the surge-capacity requirements. Operational commanders may be forced to find significant financial resources on short notice to meet operational requirements.

For the far term, the high data rate systems will provide "bandwidth-on-demand" that may be able to meet the surge requirements of operational users.

	Lease-Near Term	Lease-Far Term
Availability?	No	Maybe
Incentives?	Yes	Yes
US Control?	No	No
Legacy Equipment?	No	Yes
HNA Pre-negotiated?	No	Yes
Regional Coverage?	No	Yes
Cost Effective?	No	Yes
Operational Responsiveness?	No	Yes

Table 2: Spot Market Lease Framework Summary

Cascade Strategy

Finally, a third proposed conceptual framework is known as the cascade strategy. This framework frees up MILSATCOM resources by temporarily moving some operational users from MILSATCOM to commercial SATCOM or fiber-optic land lines. The capacity made available by the cascading of some of the fixed users to commercial SATCOM would then "open-up"

MILSATCOM capacity to meet tactical surge requirements.[52] The cascade strategy takes advantage of many of the concepts proposed in the SATCOM CRF framework. It enables capacity requirements to be met by pre-planning those users that will "cascade" to commercial SATCOM. Figure 4 illustrates how this framework would be executed.

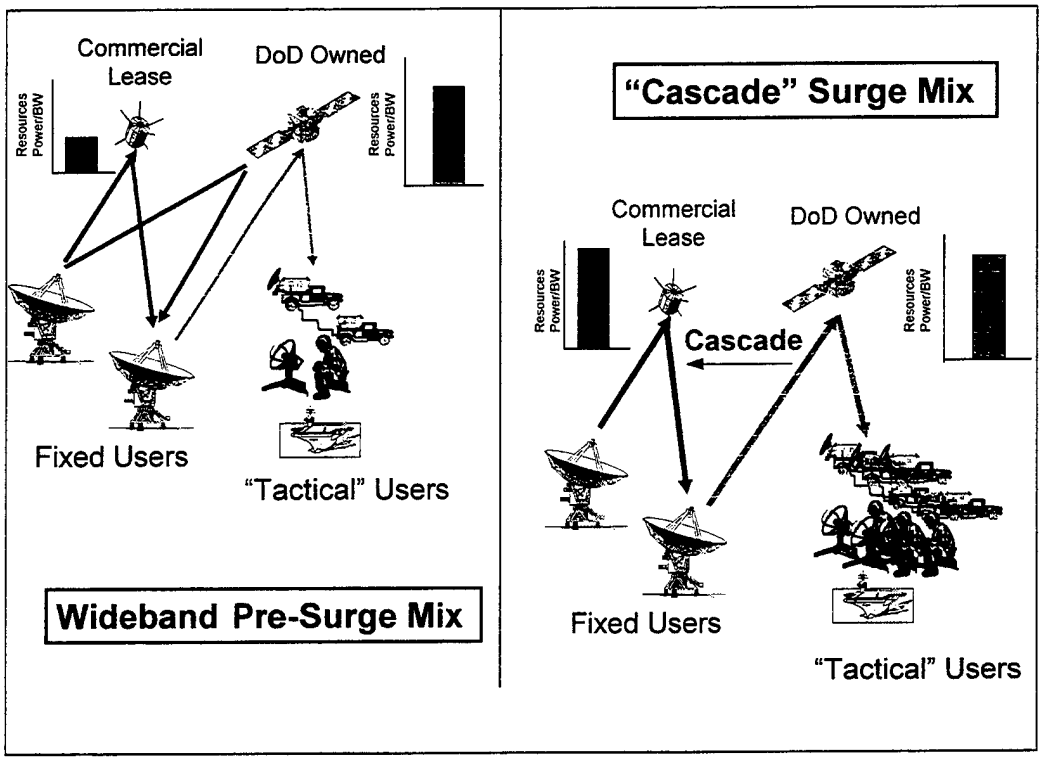

Figure 4: Description of Cascade Strategy[53]

USSPACECOM/J6 is currently leading a Commercial Surge Strategy Team to investigate the details of how this framework would be exercised. It is looking at fixed sites that would be the most likely candidates to move to commercial SATCOM or fiber in the event of a crisis requiring surge-capacity communications.

Availability: In the near term, this framework has the same constraints as the SATCOM CRF framework. There is simply not enough commercial SATCOM readily available to meet surge requirements. However, as was mentioned above in the SATCOM CRF section, when innovative

acquisition strategies are combined with pre-positioned assets and pre-negotiated contracts, the amount of readily-available commercial SATCOM increases.

In the far term, high data rate systems like Teledesic or GALAXY/SPACEWAY would be able to function much like the airline CRAF does today and may be able to meet military surge-capacity requirements.

Incentives: In the near term, like the other frameworks, there is little incentive for commercial SATCOM providers to participate. However, if the DoD were to lease preemptable transponders, when they return them to the market to be resold, the commercial provider would receive a "premium" to market that excess capacity. This could serve as an incentive for commercial SATCOM providers to participate in the cascade strategy framework.

In the far term, to take advantage of the new high data rate systems, the government may be able to guarantee a certain level of traffic in exchange for priority service in times of crisis.

US Control: Like the other frameworks, exclusive US control of commercial SATCOM will be difficult to find in the international SATCOM marketplace.

Legacy Equipment: The cascade strategy framework ensures that the existing MILSATCOM terminals will be used as they were designed, in support of tactical operations. For general purpose users, that would be cascaded from MILSATCOM to commercial SATCOM, the military and commercial users are very similar since they both operate from large terminals in heavily populated areas.[54] Commercial SATCOM terminals could be pre-positioned and existing MILSATCOM terminals could be transitioned to the new operational users. Thus, this option allows the maximum use of legacy terminals.

HNA Pre-negotiated: The cascade strategy framework also allows the commercial SATCOM providers to pre-negotiate HNA. The DoD could pre-select the requirements that would be transitioned in the event of a "cascade" and HNA could be secured in advance.[55]

Regional Coverage: The cascade strategy framework is regionally focused. It requires pre-crisis planning for each region on the globe.

> The key component of making a Cascade Strategy work is pre-crisis planning. The DoD must develop a strategy for each region of the globe by pre-negotiating the commercial surge strategy for different users and must also outfit those sites with the appropriate terminals to enable the transition.[56]

Thus, regional coverage would be established in the pre-crisis planning stages.

Cost Effective: This framework takes advantage of the strengths of the commercial SATCOM marketplace -- fixed, bulk, long-haul communications. MILSATCOM resources would be freed up for those hard-core and core users that would require MILSATCOM. By adding some of the concepts from the SATCOM CRF framework, such as up-front investment and innovative acquisition strategies, this framework becomes very cost effective. In addition, the overall cost to DoD would be decreased since resources would not be held unused until a surge crisis.[57]

Operational Responsiveness: This framework best meets the surge-capacity requirements of operational commanders. By cascading fixed users to commercial SATCOM, and taking advantage of some of the innovative strategies highlighted in the SATCOM CRF framework, the cascade strategy offers the best opportunity to meet surge-capacity requirements. However, this framework requires significant involvement of operational commanders for pre-crisis planning and prioritization of users to ensure that the surge capacity is available when needed.

	Cascade-Near Term	Cascade-Far Term
Availability?	Maybe	Yes
Incentives?	No	Yes
US Control?	No	No
Legacy Equipment?	No	Yes
HNA Pre-negotiated?	Yes -- Pre-planned	Yes
Regional Coverage?	Yes -- Pre-planned	Yes
Cost Effective?	Yes	Yes
Operational Responsiveness?	Yes	Yes

Table 3: Cascade Strategy Framework Summary

CONCLUSION

Communications are critical to every military operation. When US forces deploy to remote locations around the world, with little advance warning, SATCOM offers immediate connectivity virtually anywhere on the globe. Information superiority and network centric warfare will demand greater capacities from SATCOM systems. Some estimates for 2005 place the demand for capacity as high as 100 times that required for Desert Storm.[58] MILSATCOM cannot meet the demands of today's warfighters and augmentation by commercial SATCOM must be considered. The challenge lies in how to quickly acquire and operationalize commercial SATCOM capacity to meet surge requirements.

Research indicates that a SATCOM Civil Reserve Fleet will not be able to provide the surge-capacity needed to meet the needs of today's operational commanders. The demand is too great and the military has not provided incentives necessary to entice industry to participate. One promising option, the cascade strategy, temporarily moves some MILSATCOM users to commercial SATCOM or fiber-optic nodes to meet the expected surge-capacity requirements. Combining the cascade strategy with active involvement of operational commanders through pre-crisis planning, innovative acquisition strategies and some up-front investment will help achieve operational user's surge-capacity requirements.

The demand for commercial SATCOM and the resulting bandwidth will continue to grow in both the military and commercial communities. Commercial SATCOM providers need to be enticed to support the warfighters with solutions that would benefit both communities. The DoD must demonstrate a concerted effort to partner with commercial providers and promote innovative acquisition strategies, commit financial resources, and identify cascade candidates to meet the connectivity needs of operational commanders.

RECOMMENDATIONS

To meet the current and growing communication requirements of operational commanders, the Defense Information Systems Agency (DISA), USSPACECOM, and the AOR users should cooperate to solve the surge-capacity problem. Three recommendations initiate the process of implementing the cascade strategy.

1. DISA, through the Commercial Satellite Communication Initiative (CSCI) office should continue work with commercial industry to provide innovative acquisition strategies, incentives, and financing options. These can serve as models to be applied by regional users and international consortia to meet surge requirements.
2. Clearly, the "one size fits all" approach will not work. Each region has unique requirements and potentially different commercial SATCOM providers (e.g., Arabsat, Asiasat). USSPACCECOM should accelerate its efforts with the Commercial Surge Strategy Team to:[59]
    a. Identify fixed terminal candidates that can move to commercial SATCOM or commercial fiber.
    b. Identify commercial SATCOM resources and the associated costs for each Area of Responsibility (AOR).
    c. Coordinate with the CINCs/Services/Agencies to develop the cascade strategy to temporarily move fixed communications from military SATCOM systems to commercial fiber or commercial SATCOM during surge-capacity crises.
3. Finally, operational users in each AOR should work closely with USSPACECOM and DISA to mature the pre-crisis planning process and identify those terminals that can be "cascaded" to commercial fiber or commercial SATCOM during contingencies. In addition, exercises should be scheduled to practice the "cascade" process, saturate the capacity, and identify shortfalls.

NOTES

[1] Paul Kaminski, A Year Later: A Report Card-Any Outside-The-Box Thinking?, Keynote address to 2nd Annual Space Policy and Architecture Symposium, 11 February 1997, <http://www.fas.org/spp/military/docops/defense/speech2.htm>, (29 November 1999), 4.

[2] Pamela Houghtaling, "Agencies Eye Commercial Birds as Interest in Satellites Grows," Federal Computer Week, 11 November 1996; <http://www.fcw.com/fcw/articles/fcw_111196_1215.asp>, (23 January 2000), 2.

[3] John Pike, "Desert Storm, Military Space Communications," Space Policy Project, 7 April 1997, <http://www.fas.org/spp/military/docops/operate/ds/communications.htm>, (14 January 2000), 8.

[4] Gbps is an abbreviation for Giga-bits per second. A giga-bit is 1 Billion bits. The average computer modem can transfer data at 56.6 thousand (kilo) bits per second.

[5] Daniel Gonzales, The Changing Role of the U.S. Military in Space, (Santa Monica, CA: RAND, 1999), xiii.

[6] Department of Defense, Report to Congress on Impediments to the Innovative Acquisition of Commercial Satellite Communications, (Washington: 1998), 6.

[7] Matthew Marshall, ed., Commercial Space Opportunities Study, Communications Panel Final Report, (Aerospace Corporation: 12 November 1999), 2.

[8] Ibid., 2.

[9] John Capulli, "Commercial Space Communications for Milsatcom," American Institute of Aeronautics and Astronautics 98-5292, 28 October 1998, 234.

[10] United States Space Command (USSPACECOM), "Chapter 7," USSPACECOM Long Range Plan, March 1998, <http://www.spacecom.af.mil/usspace/LRP/ch07.htm>, (29 November 1999), 1.

[11] Camille Dobbs and Justin Keller, "Commercial Communications Analogy to Civil Reserve Air Fleet (CRAF)," (Washington DC: Joint Staff Directorate for C4 Systems, October 1999), 4.

[12] General Accounting Office, DEFENSE SATELLITE COMMUNICATIONS, Alternative to DoD's Satellite Replacement Plan Would Be Less Costly, Report to the Secretary of Defense (Washington:, July 1997), 4.

[13] DoD, DoD Report to Congress on Impediments, 5.

[14] Marshall, ed., 12.

[15] The equipment, including receiver, transmitter, and antenna, on a communication satellite that receives a signal from an earth station, shifts the signal from the uplink to the downlink frequency, and amplifies and retransmits the signal to another earth station or stations.

[16] Defense Information Systems Agency, "Program Overview," Commercial Satellite Communications Initiative, <http:// www.disa.mil/d3/csci/aboutcsci.htm>, (18 December 1999), 1.

[17] Capulli, 236.

[18] Hughes Global Services, "ABOUT Hughes Global Services," <http://www.hughesglobal.com/aboutco.htm>, (23 January 2000), 1.

[19] DoD, DoD Report to Congress on Impediments, 5.

[20] "Bandwidth-On-Demand." "Bandwidth" refers to the amount of data that can be transmitted in a fixed amount of time. For digital systems, it us usually measured in bits per second (bps). "On Demand" means that each subscriber uses satellite resources only for the time they are communicating rather than setting up a dedicated channel (under previous technology) for an extended period of time.

[21] Department of Defense, Leveraging Commercial Communications Satellite Technology and Investments to Meet Defense Needs, (Washington: December 1998), 117.

[22] Hans Binnendijk, ed., 1998 Strategic Assessment, Chapter 16, Institute for National Security Studies, National Defense University, <http://www.ndu.edu/inss/ sa98/sa98ch16.html> (14 December 1999), 1.

[23] Dobbs and Keller, 4.

[24] Marshall, ed., 3.

[25] Ibid., 2.

[26] Ibid.

[27] Jose Torres, Interference Mitigation Capability for Enhanced Deployability of Commercial Wireless Communications, <http://www.mitre.org/tech99/tech99/poster99_boards/torres_poster.ppt>, (22 January 2000), 1.

[28] Marshall, ed., 5.

[29] Patrick Rayerman, Lt Col, USA, Chief, Space Operations, DISA, interview by author, 3 February 2000.

[30] Dobbs and Keller, 4.
[31] Ibid., 1.
[32] Charles A. Post, Jr. CRAF Incentives, (Air University, Maxwell AFB, AL: November 1996), 4.
[33] Ibid., 2.
[34] Dobbs and Keller, 5.
[35] Dobbs and Keller, 4.
[36] Post, 29-30.
[37] Ibid., 1.
[38] Dobbs and Keller, 4.
[39] Capulli, 237.
[40] Dobbs and Keller, 3.
[41] Gonzales, 21.
[42] Dobbs and Keller, 3.
[43] Ibid., 1.
[44] Terminal: Equipment (including antennas and signal processing electronics) used to transmit signals to the satellite and receive signals from the satellite.
[45] DoD, DoD Report to Congress on Impediments, 13.
[46] Ibid.
[47] Capulli, 235.
[48] DoD, Leveraging Commercial Communications, 6.
[49] Dobbs and Keller, 3.
[50] DoD, Report to Congress on Impediments, 11.
[51] Gonzales, 21.
[52] Dobbs and Keller, 4.
[53] Ibid.
[54] Ibid.
[55] Ibid.
[56] Ibid.
[57] Ibid.
[58] Gonzales, xii.
[59] Tucker, Mona Lisa, 1 February 2000, "MEMORANDUM FOR RECORD, Commercial Surge Strategy Team Meeting," USSPACECOM/J6SS, Colorado Springs, CO.

APPENDIX

DoD Direct Procurement

Another conceptual framework proposes that the DoD should directly procure commercial satellites to meet surge-capacity requirements. This framework could not be implemented in the near term since it would require at least a three to five year procurement cycle. Thus, this framework will only be evaluated on its ability to meet far-term requirements.

Availability: This framework would ensure that enough resources were available to meet surge requirements. However, to procure enough SATCOM assets to meet all of the surge-capacity requirements would require a large portion of the capability to sit unused until a surge condition exists.

Incentives: This framework assumes that all satellites procured would become part of the MILSATCOM architecture. Thus, there would not be any commercial SATCOM participation and incentives would not apply.

US Control: This framework would ensure that the US military or contracted agents would have complete control over the entire system.

Legacy Equipment: This framework could procure SATCOM systems that would be compatible with existing legacy equipment.

HNA Pre-negotiated: This framework, since it is simply adding capability to the MILSATCOM architecture would be covered under the various "Status of Forces" agreements that allows MILSATCOM "landing rights" in any country that invites US military forces to operate within its boundaries.

Regional Coverage: By procuring commercial satellites this system would be designed to maximize global coverage and ensure surge capacity is available.

Cost Effective: Virtually all of the studies have shown that long-term leasing of SATCOM is more expensive than DoD directly procuring a system.[60] For example, the National

Security Space Architect's SATCOM Architecture Development Team released a study in 1996.

> In one part of the study, all the requirements for wideband service (over 5.5 Gbps) were allocated to commercial systems... the total costs [for leasing] exceeded... $10 billion for a 10 year period. By comparison, the transition architecture's wideband, commercial-variant, military segment would have cost less than $2.5 billion for a 10-year constellation, including launch. The lease/buy ratio in this case was about 4 to 1... The conclusion these studies have drawn is that for long-term, bulk communications, procurement of a satellite capability is less expensive than leasing.[61]

Thus, when communication requirements can be "bundled" to fill an entire satellite, direct DoD procurement is a cost-effective and operationally sound option. However, as was discussed in the availability section above, the purpose for this framework is to meet surge requirements and much of this capacity could sit unused until a crisis erupts. Thus, this requirement is not cost effective.

Operational Responsiveness: This conceptual framework would ensure that the designed SATCOM architecture would be able to meet all surge-capacity requirements of operational users around the globe.

	DoD Procure-Near Term	DoD Procure -Far Term
Availability?	N/A	Yes
Incentives?	N/A	N/A
US Control?	N/A	Yes
Legacy Equipment?	N/A	Yes
HNA Pre-negotiated?	N/A	Yes
Regional Coverage?	N/A	Yes
Cost Effective	N/A	No
Operational Responsiveness?	N/A	Yes

Table A-4: DoD Direct Procurement Framework Summary

[60] DoD, Report to Congress on Impediments, 15.
[61] Ibid., 15.

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